Lesson 5 How to use the ultrasonic module to measure distance

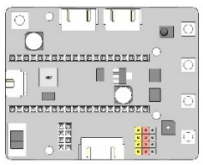
Ultrasonic Distance Sensor module supports a contactless detection within a distance of 2cm-400cm. It contains an ultrasonic emitter, receiver and control circuits.

Notes:

1. The module is not suggested to connect wires when power is on. If you have to do so, please first connect the GND and then other pins; otherwise, the module may not work.

2. During the ranging, the area of the targeted object should be no less than 0.5cm and the surface facing the module should be as flat as possible; otherwise the result may be inaccurate.

5.1 Components & Parts

Components	Quantity	Picture	Remark
Raspberry Pi Pico	1		
USB Cable	1		
Pico HAT	1		
Ultrasonic Sensor Module	1		Not included in the Kit,you can prepared by yourself

4 Pin wire	1		

5.2 How the Ultrasonic Module Works

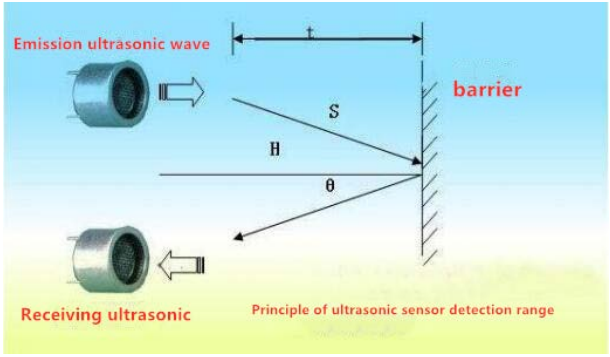
The ultrasonic ranging module usually has four pins, namely VCC, GND, Echo and Trig. The HC-SR04 can provide a non-contact distance sensing function of 2cm-400cm, and the ranging accuracy can reach 3mm; The module includes an ultrasonic transmitter, receiver and control circuit. The basic working principle is as follows:

Use IO port TRIG to trigger distance measurement, and give a high level signal of at least 10us.

The module automatically sends eight 40khz square waves, and automatically detects whether there is a signal return.

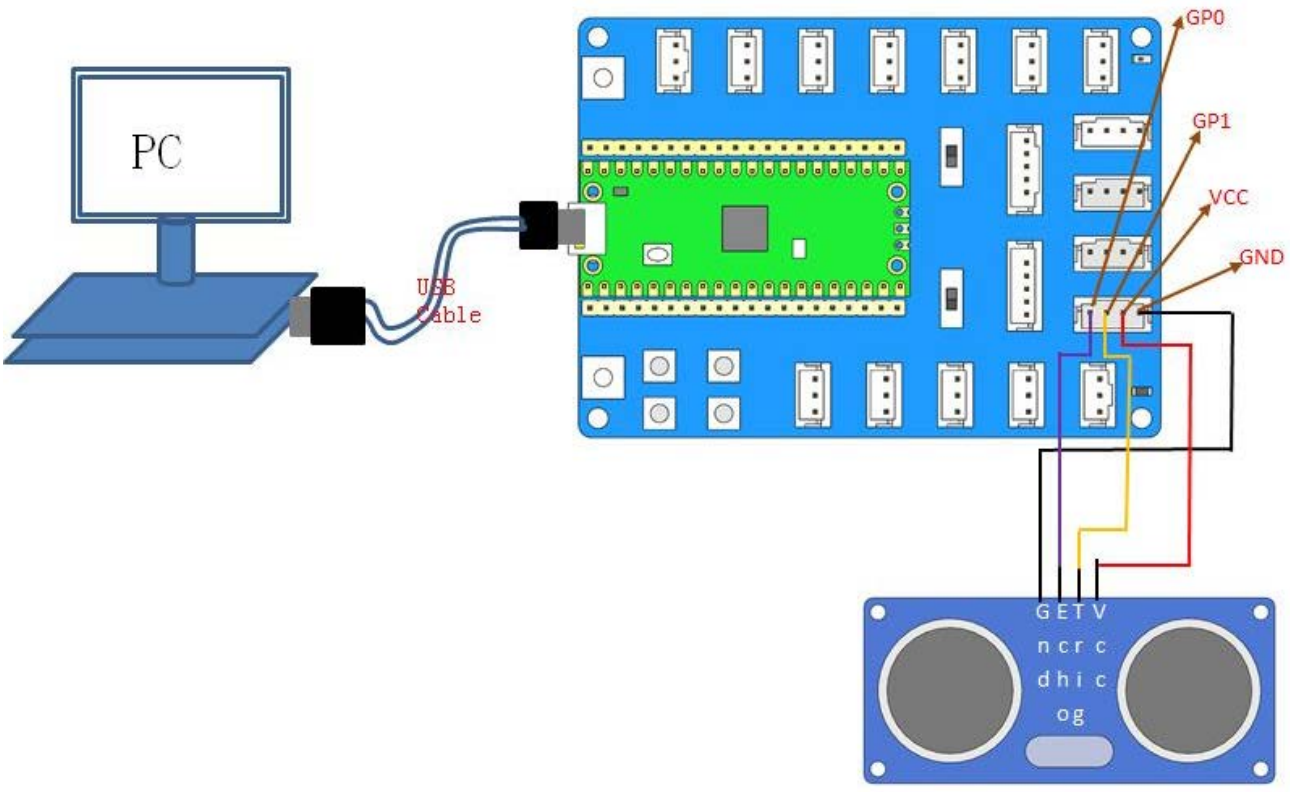
There is a signal return, and a high level is output with the IO port ECHO. The duration of the high level is the time from emission to return of the ultrasonic wave.

The principle of distance detection by ultrasonic ranging sensor: the method of detecting distance by ultrasonic is called echo detection method, that is, the ultrasonic transmitter emits ultrasonic waves in a certain direction, and the timer starts timing at the same time as the launch time. The ultrasonic waves propagate in the air and encounter obstacles on the way. When the object surface (object) is blocked, it will be reflected back immediately, and the ultrasonic receiver will immediately stop timing when the reflected ultrasonic wave is received. The propagation speed of ultrasonic waves in the air is 340m/s. According to the time t recorded by the timer, the distance s from the launch point to the obstacle surface can be calculated, namely: s=340t/2. Using this principle of ultrasound, the ultrasonic ranging module is widely used in practical applications, such as car reversing radar, unmanned aerial vehicle, and smart car.



5.3 Circuit

The hardware connection circuit as below,in this lesson, we use GP0 of Pico to connect with Echo pin of ultrasonic ranging module,use GP1 of Pico to connect with Trig pin of ultrasonic ranging module.

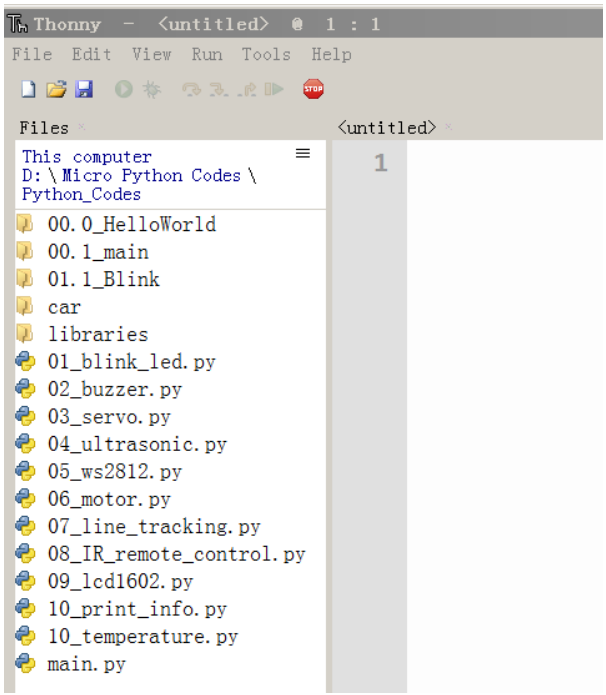


This experiment uses the Ultrasonic Distance Sensor module to detect the distance between the obstacle and module and show the detection distance sensed on the Thonny.

5.4 Run the program

5.4.1 Codes used in this tutorial are saved in "Pico Expansion Kit Tutorial\Lessons for Python\Python_Codes".You can move the codes to any location. For example, we save the codes in Disk(D) with the path of "D:/ Micro Python codes".

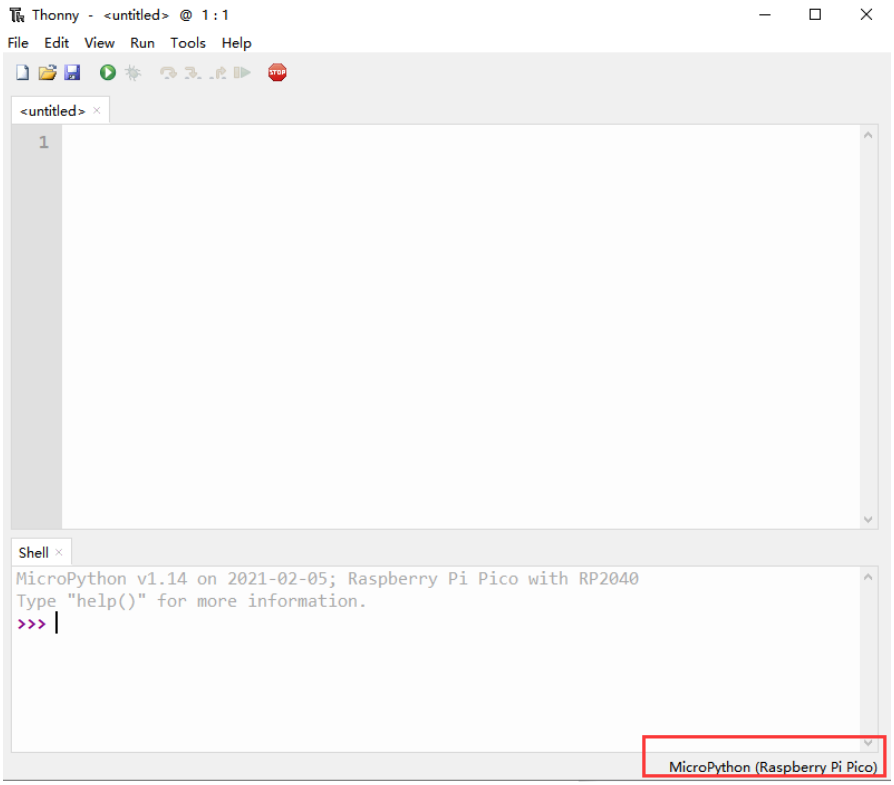
5.4.2 Open “Thonny”， click “View”--“Files”--“This computer”--“D:”--“Micro Python Codes”--“Python_Codes”.



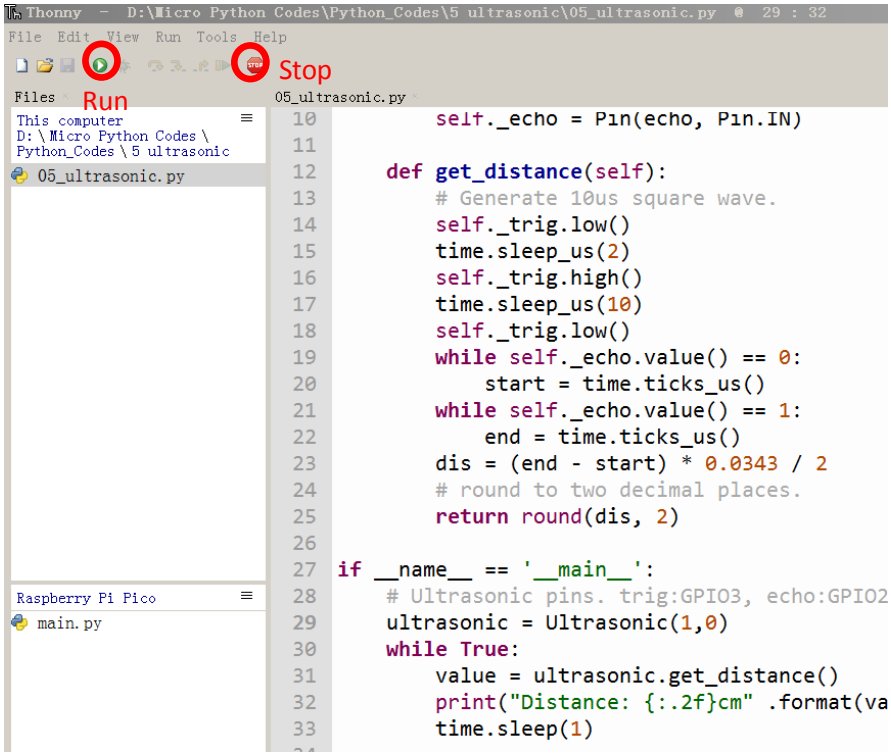
This computer: The file area of the personal computer.

Raspberry pi Pico: Pico file area, the code saved in Pico can be viewed in this area.

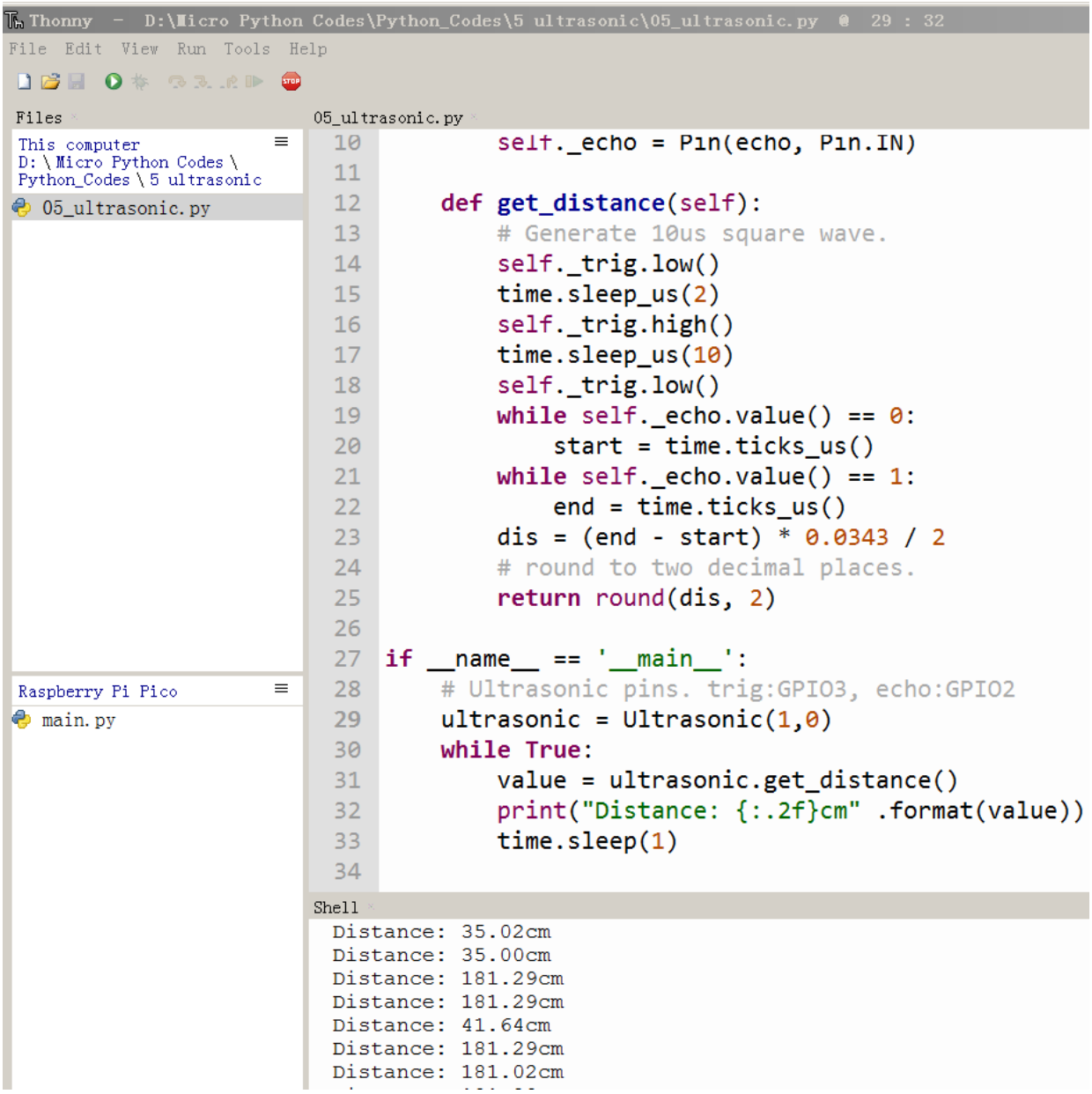
5.4.3 Confirm that "MicroPython (Raspberry Pi Pico)" is displayed in the lower right corner. If it is not, please click the font in the lower right corner to select "MicroPython(Raspberry Pi Pico)" mode.



5.4.4 Double-click the code "05_ultrasonic.py" required for this course. The content of the code will be displayed in the interface on the right.



5.4.5 Click the run button on Thonny interface to run the program.Now, you will see the distance to the obstacle at front of the Ultrasonic Distance Sensor module displayed on the Thonny.



5.4.6 Click the stop button to stop the program.

5.5 Code

05_ultrasonic.py

```
1.  from machine import Timer,Pin, PWM, ADC
2.  #from machine import time_pulse_us
3.  import time, array
4.  import math
5.
6.  class Ultrasonic():
7.      # Define output(trig) and input(echo) pins.
8.      def __init__(self, trig, echo):
9.          self._trig = Pin(trig, Pin.OUT)
10.         self._echo = Pin(echo, Pin.IN)
11.
12.     def get_distance(self):
13.         # Generate 10us square wave.
14.         self._trig.low()
15.         time.sleep_us(2)
16.         self._trig.high()
17.         time.sleep_us(10)
18.         self._trig.low()
19.         while self._echo.value() == 0:
20.             start = time.ticks_us()
21.         while self._echo.value() == 1:
22.             end = time.ticks_us()
23.         dis = (end - start) * 0.0343 / 2
24.         # round to two decimal places.
25.         return round(dis, 2)
26.
27. if __name__ == '__main__':
28.     # Ultrasonic pins. trig:GPIO1, echo:GPIO0
29.     ultrasonic = Ultrasonic(1,0)
30.     while True:
31.         value = ultrasonic.get_distance()
32.         print("Distance: {:.2f}cm" .format(value))
33.         time.sleep(1)
```

5.6 What's Next?

THANK YOU for participating in this learning experience!

If you find errors, omissions or you have suggestions and/or questions about this Lesson, please feel free to contact us: cokoino@outlook.com

We will make every effort to make changes and correct errors as soon as feasibly possible and publish a revised version.

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